



Cambridge O Level

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COMBINED SCIENCE**5129/21**

Paper 2 Theory

October/November 2025**1 hour 45 minutes**

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **16** pages.

- 1 Draw straight lines from the box on the left to **three** of the boxes on the right to make three sentences that are correct for veins.

Veins ...

... carry blood at a higher pressure than arteries.

... always carry deoxygenated blood.

... have a narrow lumen.

... have a thinner wall than arteries.

... carry blood towards the heart.

... have many valves to prevent the backflow of blood.

Fig. 1.1

[3]



- 2 (a) State the percentage of nitrogen gas, N_2 , in clean, dry air.

.....% [1]

- (b) State the type of bonding in a molecule of nitrogen gas.

..... [1]

- (c) Nitrogen reacts with calcium, Ca, to form calcium nitride, Ca_3N_2 .

- (i) Calculate the relative formula mass, M_r , of calcium nitride, Ca_3N_2 .

The relative atomic masses, A_r , of calcium and nitrogen are shown.

[A_r : Ca, 40; N, 14]

$M_r =$ [1]

- (ii) Calcium nitride melts at 1195°C .

Deduce the type of bonding in calcium nitride.

..... [1]

- (iii) Describe the separation and motion of the particles in melted calcium nitride.

separation

.....

motion

.....

[2]

[Total: 6]



- 3 An athlete throws a heavy shot put ball in a competition.

Fig. 3.1 shows how the height of the ball above the ground changes with time.

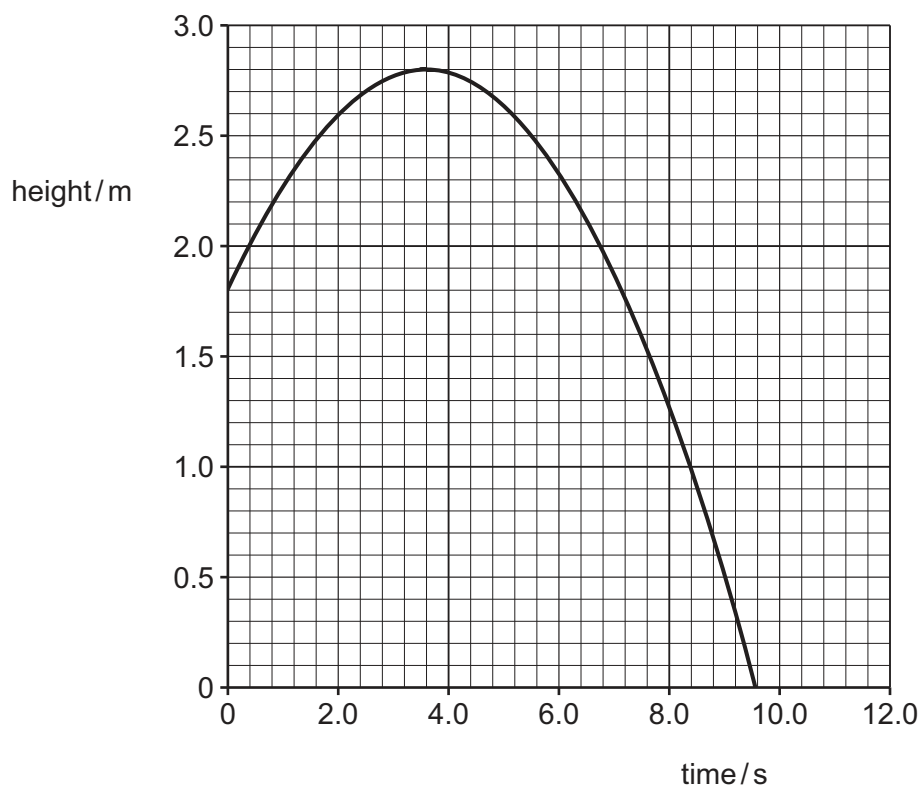


Fig. 3.1

- (a) Use the information in Fig. 3.1 to determine:

- (i) the height of the ball above the ground when it is released by the athlete.

height above the ground = m [1]

- (ii) the time taken for the ball to land on the ground.

time taken = s [1]

- (b) Explain how the graph shows that the speed of the ball is changing.

..... [1]

- (c) The ball travels a horizontal distance of 19.3 m.

Calculate the average horizontal speed of the ball.

Use your answer to (a)(ii) in your calculation and give your answer to 2 significant figures.

average speed = m/s [3]

[Total: 6]



- 4 (a) Inspired air is air that is breathed in, and expired air is air that is breathed out.

Complete the sentences comparing inspired and expired air.

Inspired air has more than expired air.

Expired air has more than inspired air.

[2]

- (b) The breathing rate of a student is measured for 10 minutes.

He stands still for most of the 10 minutes.

He exercises for a short period of time during the 10 minutes.

Fig. 4.1 shows how his breathing rate changes from the start of the 10 minutes to the beginning of minute 6.

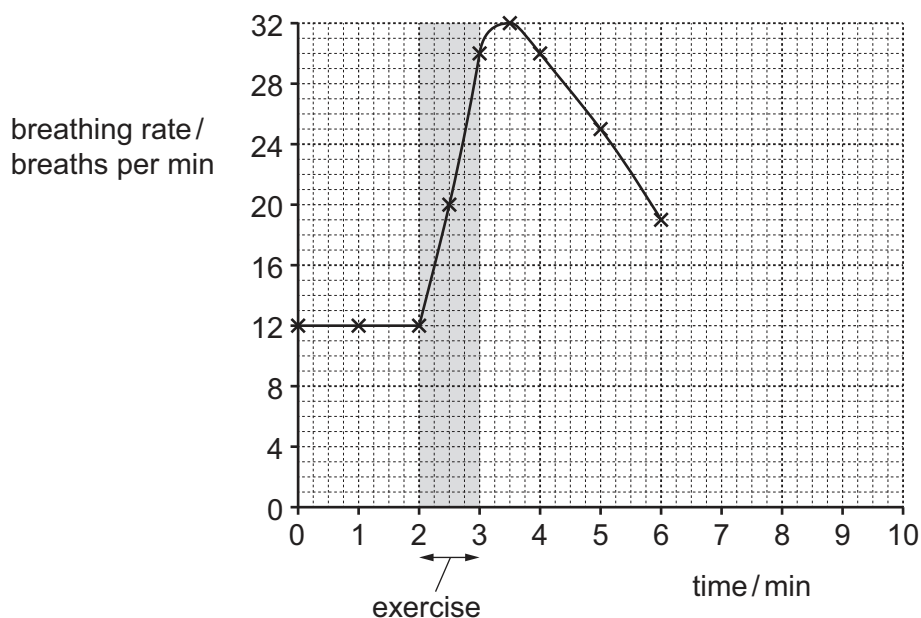


Fig. 4.1

- (i) Use the graph to determine the student's breathing rate when the student is standing still before exercising.

..... breaths/min [1]

- (ii) Use the graph to determine the duration of the exercise period.

..... min [1]

- (iii) Calculate the **increase** in the student's breathing rate caused by the exercise.

..... breaths/min [1]

- (iv) The line on the graph in Fig. 4.1 is incomplete.

Draw on the graph to continue the line from 6 to 10 minutes to show how the student's breathing rate changes. [2]



5 Table 5.1 shows the structural formulas of two hydrocarbons, **A** and **B**.

Table 5.1

A	B
$\text{CH}_2=\text{CH}_2$	$\text{CH}_3\text{CH}_2\text{CH}_3$

(a) State the name of hydrocarbon **A** and the name of hydrocarbon **B**.

A

B [2]

(b) Describe **one** similarity and **one** difference in the structures of **A** and **B**.

similarity

.....

difference

..... [2]

(c) State a use for hydrocarbon **A**.

..... [1]

(d) Explain the meaning of the term 'structural formula'.

.....

..... [1]

[Total: 6]



- 6 Fig. 6.1 shows a block of wood on a ramp. The ramp is tilted so that one end is at height h above the bench.

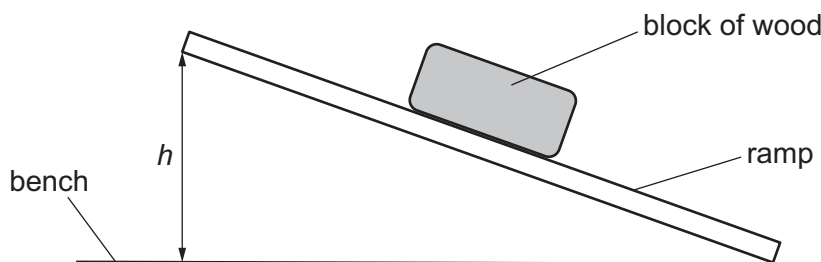


Fig. 6.1

- (a) A force prevents the block sliding down the ramp.

(i) State the name of this force.

..... [1]

(ii) On Fig. 6.1, draw an arrow to show the direction of this force. Label this arrow with an **X**. [1]

- (b) The height h is increased until the block begins to slide down the ramp.

Explain why the block begins to slide.

..... [2]

- (c) Energy is transferred between energy stores associated with the block as the block slides down the ramp.

(i) State the name of the energy store that decreases.

..... [1]

(ii) State the name of an energy store that increases.

..... [1]

[Total: 6]



- 7 Use words from the list to complete the sentences about sexual reproduction in humans.

Each word may be used once, more than once, or not at all.

abdomen

embryos

gametes

neurone

ovary

scrotum

sperm

zygotes

A testis is found inside the

A testis produces cells which are the male

Egg cells are produced inside the

[4]

- 8 Table 8.1 shows the chemical equations for five different reactions **V**, **W**, **X**, **Y** and **Z**.

Table 8.1

label	chemical equation
V	$\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
W	$\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
X	$\text{CaCl}_2(\text{aq}) + 2\text{KOH}(\text{aq}) \rightarrow 2\text{KCl}(\text{aq}) + \text{Ca}(\text{OH})_2(\text{s})$
Y	$\text{C}_{20}\text{H}_{42} \rightarrow \text{C}_{10}\text{H}_{20} + \text{C}_3\text{H}_6 + \text{C}_7\text{H}_{16}$
Z	$\text{CuO} + \text{Mg} \rightarrow \text{Cu} + \text{MgO}$

State which equation, **V**, **W**, **X**, **Y** or **Z**, is an example of the type of reaction named in question parts (a) to (e).

Each equation may be used once, more than once or not at all.

(a) precipitation

..... [1]

(b) neutralisation

..... [1]

(c) redox

..... [1]

(d) cracking

..... [1]

(e) complete combustion

..... [1]

[Total: 5]



9 (a) Describe how useful electrical power may be obtained from nuclear fuel.

.....

.....

.....

.....

.....

..... [4]

(b) Describe **one** advantage of using nuclear fuel to produce electrical power.

.....

..... [1]

[Total: 5]

10 Human activity has impacts on ecosystems.

(a) Describe **two** effects of pollution by untreated sewage on freshwater ecosystems.

1

.....

2

.....

[2]

(b) Describe **two** effects of introducing non-native species into ecosystems.

1

.....

2

.....

[2]

[Total: 4]



11 (a) Copper is a metal.

The melting point of copper is 1083°C .

The boiling point of copper is 2595°C .

Use this data to deduce the physical state of copper at 2000°C . Explain your reasoning.

physical state

explanation

[2]

(b) State a use for copper metal and the property that makes it suitable for that use.

use

property

[2]

[Total: 4]



12 Fig. 12.1 shows apparatus used to demonstrate convection.

A piece of smoking paper is placed above a glass tube attached to a box. A lit candle is placed inside the box, below another glass tube.

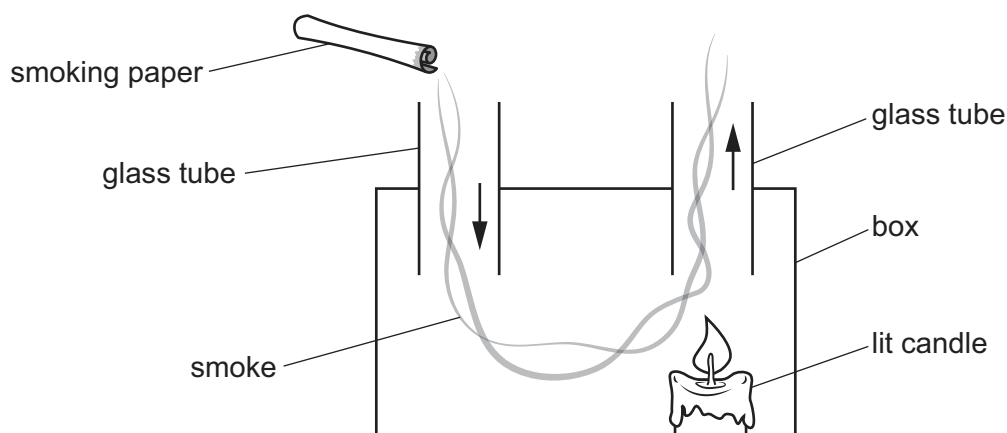


Fig. 12.1

Each arrow shows the direction of the smoke as it moves through that part of the box.

(a) Explain why the smoke moves in the directions shown in Fig. 12.1.

.....

.....

..... [2]

(b) The lighted candle emits radiation with a wavelength of $12 \times 10^{-6} \text{ m}$.

The speed of light in air is approximately $3.0 \times 10^8 \text{ m/s}$.

Calculate the frequency of this radiation.

The wavelength and the speed are given in standard form.

Give your answer in standard form.

frequency = Hz [4]

[Total: 6]



13 Some of the organs of the human digestive system are labelled with the numbers 1–7 on Fig. 13.1.

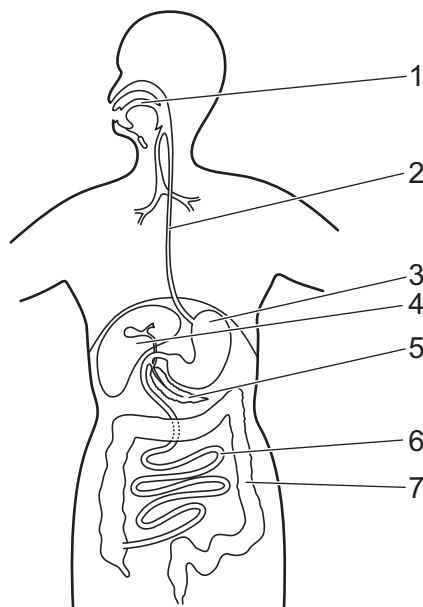


Fig. 13.1

Complete Table 13.1 by inserting the number from Fig. 13.1 that identifies the organ where the function occurs.

Each number may be used once, more than once or not at all.

Table 13.1

function	number of organ
produces urea	
bacteria are killed	
absorbs water	
stores glycogen	
produces amylase, lipase and protease	

[5]



14 A reaction between zinc metal and nitric acid produces a salt and hydrogen gas.

(a) State the name of the salt produced in the reaction.

..... [1]

(b) Describe the test and the result of the test that confirms that hydrogen gas is produced.

test

result

..... [2]

(c) The rate of this chemical reaction is increased by using a catalyst and by increasing the temperature of the reactants.

State **two** other ways to increase the rate of this chemical reaction.

1

2 [2]

[Total: 5]



- 15 Fig. 15.1 shows apparatus used to demonstrate electrical charge. The metal dome is given a charge that results in a very high potential difference between it and the ground.

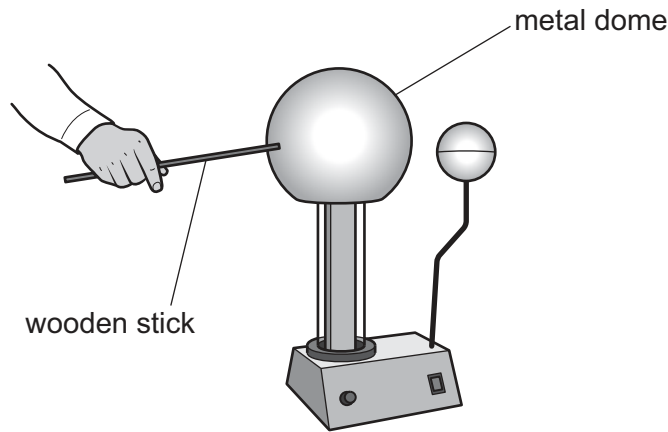


Fig. 15.1

A teacher uses a wooden stick to discharge the metal dome.

- (a) The charge Q on the dome is initially $1.6 \times 10^{-6} \text{ C}$.

When the teacher touches the dome with the wooden stick, the current I in the stick is initially $7.2 \times 10^{-7} \text{ A}$.

Assume that these values of Q and I stay constant.

Calculate the time to discharge the dome.

time = s [2]

- (b) The potential difference of the charged dome is initially 110 000 V.

- (i) Suggest **one** electrical property of the wooden stick that is constant.

..... [1]

- (ii) In reality, the potential difference of the charged dome decreases as it discharges.

This means that the actual time taken to discharge the dome is more than the time calculated in (a).

Explain why the decreasing potential difference causes the time to discharge the dome to increase.

..... [1]

[Total: 4]



16 The boxes on the left contain the names of structures found in plants.

The boxes on the right contain functions performed by plant structures.

Draw **one** straight line from each structure to its function.

You must draw a total of **five** lines.

structure	function
chloroplasts	translocation of sucrose
mitochondria	aerobic respiration
phloem	photosynthesis
stomata	transport of mineral ions
xylem	gas exchange

Fig. 16.1

[4]

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The Periodic Table of Elements

Group																			
I	II													III	IV	V	VI	VII	VIII

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

